STATEMENT OF WORK (SOW)
(SW-T/SYS-06-97)

THEATER HIGH ALTITUDE AREA DEFENSE (THAAD)

SOFTWARE INDEPENDENT VERIFICATION AND VALIDATION (SIV&V)

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TABLE OF CONTENTS

SOFTWARE INDEPENDENT VERIFICATION AND VALIDATION (SIV&V)

STATEMENT OF WORK

SOFTWARE INDEPENDENT VERIFICATION AND VALIDATION (SIV&V) for the THEATER HIGH ALTITUDE AREA DEFENSE PROJECT OFFICE

1.0 SCOPE

1.1. **INTRODUCTION**. This Statement of Work (SOW) delineates the Government's requirements for scientific, engineering, analysis and technical efforts to support verification and validation of systems and computer software for the THAAD Project Office (TPO). The contractor will perform these efforts during the Program Definition and Risk Reduction (PD&RR) and the Engineering and Manufacturing Development (EMD) phases of the THAAD program. The THAAD program is scheduled to transition to the EMD phase during Fiscal Year 1999, following a Milestone II decision. The THAAD system is a Major Defense Acquisition Program (MDAP) and is an integral part of the Theater Missile Defense (TMD) architecture. THAAD will be deployed with complementary Air Defense systems having both TMD capability and capability to kill air breathing threats. The long-term objectives of the THAAD Project are to design, develop, and field a THAAD System with the mission of defending U.S./allied assets against Theater Ballistic Missile (TBM) threats in mature and non-mature theaters; provide area defense capability; and provide a defense overlay to lower tier weapon systems.

1.2 **BACKGROUND**. The major components of the THAAD weapon system include: a missile subsystem, consisting of a booster and a kinetic energy kill vehicle with infrared (IR) seeker; a mobile launcher; a battle management/command, control, communications, and intelligence (BM/C3I) subsystem consisting of battery and battalion level components; and a surveillance and tracking ground based radar (GBR). In order to independently assess THAAD's system performance and TMD interoperability capability, there is a need for a Software Independent Verification and Validation (SIV&V) effort.

2.0 APPLICABLE DOCUMENTS

Applicable documents shall be as specified on the Document Summary List (DSL) attached to the Contract Data Requirements List (CDRL).

3.0 REQUIREMENTS

3.1 GENERAL REQUIREMENTS

3.1.1 The contractor shall apply proven verification and validation (V&V) methodologies and tools to computer software being developed, managed, maintained, and supported by the THAAD Project Office and THAAD system prime contractor. The contractor shall act as a TPO independent appraiser of the developments, processes, procedures, support items, and products of systems and their associated computer software with major emphasis on achieving correct system performance and high levels of system quality.

3.1.2 The contractor shall provide V&V of THAAD system technical requirements, software analysis and design evaluation support, sizing and timing studies, test evaluation support, verification of software quality and adherence to established coding standards, and support in accreditation/validation of models and simulations. The contractor shall assess the THAAD system and Joint Service communication requirements and technical performance objectives.

3.1.3 The contractor's efforts shall include the verification of requirements, traceability of requirements, analysis of system/software documentation, review of configuration management procedures, program test and evaluation, and technical writing for a wide range of digital equipment. System types include: radar, BM/C3I, missile, launcher, position/navigation, fire control, tactical computer systems, and support equipment. The contractor shall perform requirements validation; design verification; code verification; studies; assessment and/or development of test plans, procedures, and reports; and validation of requirements for post-deployment software support, including the User Operational Evaluation System (UOES).

3.1.4 The THAAD government-furnished PD&RR Independent Verification and Validation (IV&V) testbeds, i.e., THAAD Verification and Validation System (TVVS) and THAAD Radar Test Bed (TRTB), will be moved to the U.S. Army Aviation and Missile Command (AMCOM) Software Engineering Directorate (SED) for continued testing and IV&V of the PD&RR tactical software. The contractor shall operate, maintain, and upgrade these testbeds (see 3.2.5.3), as directed by TPO, both before and after relocation to SED. The contractor shall utilize these testbeds to perform system testing, system performance assessments, pre- and post-flight analysis, requirements validation, and system integration studies.

3.1.5 The contractor shall provide technical support for the setup and integration of the EMD-configured testbeds. The contractor shall utilize these testbeds to perform system testing, system performance assessments, pre- and post-flight analysis, requirements validation, and system integration studies for THAAD EMD software and systems. Government-furnished commercial versions of the THAAD tactical mission processors and auxiliary hardware will be provided for establishment of EMD configurations of the TVVS and TRTB.

3.1.6 The contractor's technical and technical support staff shall be required to work on-site in government-furnished offices and laboratories at the AMCOM SED or other local government facilities (e.g., the Advanced Research Center (ARC)) for software testing and interfacing of IV&V testbeds with other THAAD test equipment assets. The government at these government facilities will provide standard office spaces, with telephone and computer equipment, office equipment, and laboratories. (Detailed layout is available in the THAAD SIV&V documentation collection in the U.S. Army Space and Missile Defense Command (USASMDC) library, see L-14 of RFP.)

3.1.7 The contractor will frequently be required to interact in close coordination with other contractors and government organizations. The contractor may be required to enter into agreements with any of these organizations in order to facilitate the delineation of activities and responsibilities among multiple parties, according to TPO direction.

3.2 DETAILED REQUIREMENTS

NOTE: For the remainder of this SOW, all references to TVVS and/or TRTB shall be construed as references to both the PD&RR and EMD configurations of these testbeds, unless accompanying information clearly indicates otherwise.

3.2.1 IV&V DOCUMENTATION REVIEW AND SUPPORT

3.2.1.1 The contractor shall review and analyze the THAAD PD&RR and EMD systems requirements documents for clarity, completeness, consistency, testability, feasibility, and accuracy. The contractor shall review the traceability of requirements for the radar, BM/C3I, launcher, and missile to higher level documentation such as Technical Requirements Document (TRD), Prime Item Development Specifications (PIDS), Operational Requirements Document (ORD), or System Specifications.

3.2.1.2 The contractor shall review and analyze software development products, including, but not limited to: Software

Requirements Specification (SRS), Interface Requirements Specification (IRS), Software Design Document (SDD), Interface Design Document (IDD), source code, software user's manuals (SUMs), and electronic products developed from prime contractor Computer Aided Software Engineering (CASE) tools. The contractor shall review and assess the THAAD system prime contractor/ subcontractor development and testing plans and procedures including, but not limited to: Software Development Plan (SDP), Software Development Environment (SDE), Software Test Plan (STP), Software Test Description (STD), and Software Test Report (STR), or equivalent documentation.

3.2.1.3 The contractor shall conduct analyses of the prime developer's software testing program to assess its adequacy to fully test the ability of THAAD tactical software to meet its functional requirements. These analyses shall include software test case path coverage, and software requirements traceability from test case to system and software-level requirements.

3.2.1.4 To support EMD Post-deployment Software Support Environments (PDSSE), the contractor shall review and assess system life cycle development plans, life cycle support environment documentation, software support transition plans, and computer resource management plans.

3.2.1.5 The contractor shall support risk mitigation analyses, to include early independent risk projections, for the transition of the radar, BM/C3I, launcher, and missile from PD&RR software architectures to those required for EMD in areas such as re-use, re-host, assessments of Engineering Change Proposals (ECPs), software sizing, software to hardware allocations, timing, and throughput. The contractor shall also support similar analyses for upgrades that are considered during the EMD phase of the program.

3.2.1.6 The contractor shall support TPO to coordinate all new software requirements with appropriate agencies such as Director Combat Development (DCD), U.S. Army Air Defense Artillery School (USAADASCH), Ballistic Missile Defense Office (BMDO), and the THAAD system prime contractor/subcontractors.

3.2.2 **SYSTEM SOFTWARE REQUIREMENTS VERIFICATION/VALIDATION**

3.2.2.1 The contractor will be provided monthly software metric data from the THAAD system prime contractor, when available. The contractor shall use this data to develop an independent metrics assessment and provide the result to TPO management as risk indicators of the program.

3.2.2.2 The contractor shall assess THAAD system prime contractor/subcontractor development of test peculiar software in accordance with applicable standards.

3.2.2.3 The contractor shall monitor and assess new and revised system operational requirements at the THAAD operational level to verify all phases of tactical software development. The contractor shall maintain the THAAD Operational Requirements Lists to directly reflect all requirements of the THAAD system as specified in the Capstone ORD, TRD, Test and Evaluation Master Plan (TEMP), Cost and Operational Effectiveness Analyses (COEA), Threat Documents, and Program direction/decision documents.

3.2.2.4 The contractor shall review the tactical software requirements to verify proposed or in-process additions, deletions, and modifications to THAAD requirements. The contractor shall provide verification and assessment of each proposed or in-process software requirement addition, deletion, or modification for consistency in meeting the total THAAD performance requirements. As directed by TPO, the contractor shall review Engineering Change Proposals (ECPs) submitted to TPO and provide assessments addressing the impact to software requirements and system requirements allocated to software, impact to the ability of THAAD mission software to meet performance requirements, and impact to compliance of the THAAD system with existing standards. The contractor shall provide a recommendation to TPO regarding each ECP, advise TPO of any potential program deficiencies, and prepare a recommended corrective course of action IAW DI-MISC-80048.

3.2.2.5 The contractor shall maintain, through the Project Office, an interface with the intelligence community and monitor changes to the THAAD threat as they apply to all phases of software development. The contractor shall perform a top-level assessment of all threat changes to verify that all algorithms for THAAD requirements, design, and tests are performed against the current threat. The contractor shall monitor current and projected threat analyses/systems within the user community, along with the evolving Air-Land Battle Operations doctrine to assess their impact on THAAD Software Development.

3.2.2.6 The contractor shall monitor and assess the software required for effective THAAD Tactical Operations Center (TOC) integration of the multiple Tactical Automatic Digital Information Links (TADIL) and other unique communication data links such as Automatic Target Handover System (ATHS). The contractor shall assess the impact of approved changes to the various communications protocols and interface requirements of the THAAD system software.

3.2.2.7 The contractor shall evaluate and perform assessments of the THAAD system algorithms, as directed by TPO.

3.2.3 **TESTING**

3.2.3.1 The contractor shall participate, as directed by TPO, in Computer Software Unit (CSU), Computer Software Component (CSC), Computer Software Configuration Item (CSCI), segment, and system testing for the launcher, radar, BM/C3I, and missile at the THAAD system prime contractor and/or subcontractor facilities, government test facilities, and SIV&V facilities. The contractor shall participate on Configuration Control Boards (CCBs) that resolve Software Problem Reports (SPRs), support evaluations, and perform testing of the impacts of the SPRs on the system software.

3.2.3.2 The contractor shall perform independent CSU, CSC, CSCI, segment and system testing, as directed by TPO, using the tactical system hardware and software environment, as accepted by the government from the prime developer.

3.2.3.3 The contractor shall perform static and dynamic code analysis using commercial best practices. The contractor shall conduct code complexity and efficiency analyses.

3.2.3.4 The contractor shall evaluate THAAD system and segment documentation, design, operational support plans, and communication networks to verify integration of all THAAD segments software (i.e. missile, launcher, BM/C3I, and radar). The contractor shall verify that all THAAD system software is consistent, compatible, and meets all THAAD tactical software requirements.

3.2.3.5 The contractor shall participate in interface testing with other government agencies such as AMCOM, BMDO, Joint Tactical Air Operations (JTAO), and the U.S. Air Force KHILS at Wright-Patterson AFB.

3.2.3.6 The contractor shall participate in interface testing between THAAD and upper/lower tier assets such as PATRIOT/Medium Extended Air Defense System (MEADS), High Echelon Units (HEUs), external cueing systems, and joint service systems.

3.2.3.7 The contractor shall validate BM/C3I, radar, missile, and launcher software, and coordinate the results of software validation activities with participating agencies (TPO and USAADASCH) and the THAAD system prime contractor/ subcontractors.

3.2.3.8 The contractor shall determine and develop requirements for test scenarios that support independent assessment of system performance and communicate these requirements to TPO and government intelligence organizations, as directed by TPO. The contractor shall incorporate the resulting test scenario information into applicable software test plans, procedures, and scenarios.

3.2.3.9 The contractor shall perform pre- and post-flight analysis for the THAAD flight test program. These analyses will include a characterization of the software performance and identification of software risks.

3.2.4 **SPECIAL ANALYSES AND SUPPORT**

3.2.4.1 The contractor shall maintain a quick reaction capability to support short notice taskings, unplanned special studies and analyses, working group meetings, and technical interchange meetings regarding tactical, simulation, and test software development and implementation. Reports and minutes shall be prepared IAW DI-MISC-80048. Any unique approaches or solution techniques shall be reported IAW DI-MISC-80406 and certified IAW DI-MISC-80407.

3.2.4.2 The contractor shall develop and maintain an automated digital desk-top reference outlining the various software and hardware components of the Army Tactical Command and Control System (ATCCS) family of systems. This desk-top reference shall provide a brief overview of the various ATCCS hardware, software, and interfaces, as well as issues concerning their impact on THAAD software development. The desk-top reference shall be prepared IAW DI-MISC-80048.

3.2.4.3 The contractor shall provide IV&V support for EMD PDSSE activities (e.g., planning, scheduling, transitioning, and software maintenance).

3.2.5 **IV&V TESTBED SUPPORT**

NOTE: The IV&V Government Property List (see H-12 of the RFP) details the computers, workstations, software/simulations, and tools that make up the PD&RR and EMD TVVS and TRTB. (TVVS and TRTB requirements and design documentation are available in the THAAD SIV&V documentation collection in the USASMDC library, see L-14 of RFP.)

3.2.5.1 PD&RR Testbeds Relocation

The contractor shall support, as directed by TPO, the relocation of the government-owned PD&RR testbeds, i.e., TVVS and TRTB, to

AMCOM SED. The contractor shall ensure that they are successfully transitioned and operational, and successfully integrated to interfacing testbed equipment at the SED. These activities include the planning; setup, consolidation, integration, and interfacing of the equipment upon arrival and placement at SED; and initial check-out operations. Government-furnished testbed equipment to be interfaced to TVVS and TRTB include the THAAD Test Controller (TTC), THAAD Interoperability testbed, TMTD, and operations and demonstration/display equipment.

3.2.5.2 EMD Testbeds

3.2.5.2.1 The contractor shall provide a transition plan for utilizing government-furnished commercial versions of THAAD tactical EMD mission processors in establishing fully operational EMD-configured TVVS and TRTB testbeds. After approval by TPO, the contractor shall execute this transition plan, to include procurement or development of auxiliary hardware and software, to provide working platforms of the THAAD EMD missile, radar, BM/C3I, and launcher segments.

3.2.5.2.2 Prior to delivery of the government-furnished EMD-configured TVVS and TRTB computers, the contractor shall support the planning and coordination for installation of these assets at the AMCOM SED. After delivery, the contractor shall ensure that this equipment is successfully setup, integrated, and interfaced to the TTC, THAAD Interoperability testbed, TMTD, and operations and demonstration/display testbed equipment at the SED. The contractor shall ensure that EMD TVVS and TRTB are fully operational at the AMCOM/SED location.

3.2.5.3 Testbed Operation and Maintenance

The contractor shall continue development of the government-furnished PD&RR and EMD TVVS and TRTB by making modifications and upgrades to keep them compatible and operational with evolving tactical hardware/software configurations and scenarios. The contractor shall operate and maintain both PD&RR and EMD TVVS and TRTB hardware and software environments and coordinate these activities with the THAAD system prime contractor, associated subcontractors, and TPO. The contractor shall use government-furnished equipment (GFE) hardware and tools, as available, to support testbed requirements. The contractor shall develop and maintain user operation and training material for the TVVS and TRTB.

3.2.5.4 Testbed Requirements, Integration Testing, and Utilization

3.2.5.4.1 For both PD&RR and EMD configurations of TVVS and TRTB, the contractor shall provide the design and prototype fabrication, or upgrade, of hardware and software used for integration testing of TVVS and TRTB. The contractor shall develop or acquire the hardware and software to integrate these test beds in a closed loop configuration with each other, and in configurations involving these testbeds with the THAAD Interoperability Testbed, TTC, and TMTD. This hardware and software shall be located on-site at the SED. The hardware and software to be developed/acquired will be used to support hardware-in-the-loop (HWIL) testing of both prototype and weapon system hardware; acquisition, display and reduction of data from each integrated test; test scenario definition; and the integration of multiple test beds. To the maximum extent possible, the contractor shall utilize commercial off-the-shelf (COTS) hardware and software components.

3.2.5.4.2 The contractor shall develop system-level testbed requirements for TVVS and TRTB and the capability for integration and control of these test beds, to include both hardware and software. The contractor shall coordinate all system level testbed requirements with other government agencies, as directed by TPO. The contractor shall develop requirements and the capability for data recording, display, and analysis for all IV&V system and software testing that utilizes TVVS and TRTB.

3.2.5.4.3 For all IV&V software testing, the contractor shall develop test cases, conduct the tests, and provide supporting analyses and reports.

3.2.5.5 Testbed Documentation

The contractor shall deliver Engineering Drawings and Associated Lists prepared IAW DI-DRPR-81000, and a Software User's Manual prepared IAW DI-IPSC-81443. The contractor shall deliver scientific and technical reports IAW DI-MISC-80048. The contractor shall deliver all hardware, software, along with associated products and processes, developed in support of this effort upon completion of this contract.

3.2.6 **UOES SUPPORT**

3.2.6.1 The contractor shall review/analyze UOES software products using the software IV&V processes and methodologies established to meet the requirements of sections 3.1 and 3.2 of this SOW.

3.2.6.2 The contractor shall support the UOES flight test program and perform pre- and post-flight analyses, which include characterization of software performance and identification of software anomalies and risks.

4.0 PROGRAM MANAGEMENT

4.1 REPORTING

4.1.1 The contractor shall prepare cost and man-hour traceability reports IAW DI-MGMT-81468 and DI-FNCL-80331.

4.1.2 The contractor shall prepare test procedures IAW DI-NDTI-80603. Detailed test reports of tests conducted under this SOW shall be prepared IAW DI-MISC-80048.

4.1.3 Ada (ANSI/ISO/IEC 8652-1995) shall be the implementation language for all developed software, unless a waiver is approved by the government. If the contractor recommends that any software not be implemented in the Ada software language, the contractor shall submit a waiver request for approval/disapproval by TPO, which includes supporting rationale.

4.1.4 All Ada software developed shall have been compiled on a compiler validated by the Ada Joint Program Office.

4.1.5 All software developed shall adhere to a process that complies with J-STD-016-1995.

4.1.6 The contractor shall conduct technical direction (TD) meetings on-site at the AMCOM SED facility. The TD meetings (normally required at three-month intervals) shall be structured to provide the government an up-to-date status of the contractor's technical and programmatic progress on the contract to date. Scientific and Technical Reports Summary, Progress Reports, and Final Report shall be prepared IAW DI-MISC-80048. The contractor shall prepare a Program Plan IAW DI-MGMT-80909.

4.2 SECURITY

4.2.1 The contractor shall operate in accordance with the requirements of DoD 5220.22-M, the National Industrial Security Program Operating Manual (NISPOM), and applicable supplements to the NISPOM.

4.2.2 The contractor shall incorporate Operations Security (OPSEC). The contractor shall prepare, update, and maintain an OPSEC Plan IAW DI-MGMT-80934, the U.S. Army Strategic Defense Command Industrial OPSEC Guide, THAAD Program Operations Security (OPSEC) Plan, and Army Regulation 530-1, U.S. Army Operations Security Program.

4.2.3 The contractor shall abide by the THAAD Security Classification Guide and all subsequent changes to the guide. Information that is unclassified, but which may be withheld from the public for one or more of the reasons cited in the Freedom of Information Act (FOIA) exemptions, DoD 5400.7-R, shall be designated "FOR OFFICIAL USE ONLY", and handled accordingly. The contractor shall control all unclassified technical data in accordance with DoD 5230.24, Distribution Statement on Technical Documents. In accordance with paragraph F1b, all unclassified technical documents without a distribution statement will be handled as DISTRIBUTION STATEMENT F documents until changed by the controlling DoD office.

4.2.4 The contractor shall address all requests for public dissemination or release of information relating to this contract to Commander, U.S. Army Aviation and Missile Command, ATTN: AMSMI-IN (Public Affairs Office), Redstone Arsenal, Alabama 35898, with a copy furnished to this project office.

5.0 ACRONYMS AND ABBREVIATIONS

Acronym/ Abbreviation	Definition
AMCOM	Aviation and Missile Command
ARC	Advanced Research Center
ATCCS	Army Tactical Command and Control System
ATHS	Automatic Target Handover System
BM/C3I	Battle Management/Command, Control, Communications and Intelligence
BMDO	Ballistic Missile Defense Office
CCB	Configuration Control Board
CASE	Computer Aided Software Engineering
CDRL	Contract Data Requirements List
COEA	Cost and Operational Effectiveness Analyses
COTS	Commercial Off-The-Shelf
CSC	Computer Software Component
CSCI	Computer Software Configuration Item
CSU	Computer Software Unit
DEM/VAL	Demonstration/Validation
DCD	Director Combat Development
DIS	Distributed Interactive Simulation
DSL	Document Summary List
ECPs	Engineering Change Proposals
EMD	Engineering and Manufacturing Development
FOIA	Freedom of Information Act
GFE	Government Furnished Equipment
GBR	Ground Based Radar
HEUS	High Echelon Units
HWIL	Hardware-in-the-loop
IAW	In Accordance With
IDD	Interface Design Document
IR	Infrared
IRS	Interface Requirements Specification
IV&V	Independent Verification and Validation
IVV&A	Independent Verification, Validation and Accreditation
JTAO	Joint Tactical Air Operations
MDAP	Major Defense Acquisition Program
MEADS	Medium Extended Air Defense System
NISPOM	National Industrial Security Program Operating Manual
OPSEC	Operational Security
ORD	Operational Requirements Document
PIDs	Prime Item Development Specifications
PD&RR	Program Definition and Risk Reduction
PDSSE	Post-deployment Software Support Environment
SDD	Software Design Document
SDE	Software Development Environment
SDP	Software Development Plan
SED	Software Engineering Directorate

SIV&V	Software Independent Verification and Validation
SOW	Statement of Work
SPR	Software Problem Report
SRS	Software Requirements Specification
STD	Software Test Description
STP	Software Test Plan
STR	Software Test Report
SUM	Software User's Manuals
TADIL	Tactical Automatic Digital Information Links
TBM	Theater Ballistic Missile
TD	Technical Direction
TEMP	Test and Evaluation Master Plan
THAAD	Theater High Altitude Area Defense
TISES	THAAD Integrated System Effectiveness Simulation
TMD	Theater Missile Defense
TMTD	THAAD Mobile Test Driver
TOC	Tactical Operations Center
TPO	THAAD Project Office
TRD	Technical Requirements Document
TRTB	THAAD Radar Test Bed
TTC	THAAD Test Controller
TVVS	THAAD Verification and Validation System
UOES	User Operational Evaluation System
USAADASCH	U.S. Army Air Defense Artillery School
USASMDC	U.S. Army Space and Missile Defense Command
V&V	Verification and Validation